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AUTHOR Ilott, J. F. D.; Ilott, H. G.
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ABSTRACT

The purpose of this two section, five-part monograph is to help teachers plan and organize instruction so that objectives of language learning may be met as part of technology activities. Its intended audiences are elementary teachers, elementary language arts consultants, technology teachers who work in a team with elementary teachers, and technology consultants who advise elementary teachers. The first section elaborates on the conceptual-theoretical positions of the monograph. Part 1 discusses the monograph's three conceptual bases: (1) selected theories of language acquisition; (2) the rationale for technology in the elementary school; and (3) an empirical study of child language in an elementary school technology context. The purpose of Part 2 is to sensitize the teacher to the language development potential of elementary school technology (EST) activities. Parts 3-5 (under II) blend theoretical principles with practical applications in the EST context. Part 3 summarizes the steps necessary in implementing an EST project that fosters language development. Part 4, addressed to teachers who need assistance in initiating the EST component, provides guidance in selecting a learning activity, planning its components, and implementing it with children. Part 5 addresses the need for interactive planning to capitalize upon opportunities for language development in the context of EST activities. The monograph is illustrated with 20 tables and figures; it concludes with a bibliography. (YLB)

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Language Development in the Elementary School Technology Context

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ACKNOWLEDGEMENT

The authors of this monograph have described the close relationships between the disciplines of technology and language. Beginning at early time and tracing their developments in a social context, they have brought the reader to the current emphasis on language development as part of a total effort in general education.

Based upon their own classroom observations, they have identified many of the struggles that young students experience in their attempts to master terminology as part of the industrial arts/technology education curriculum. This monograph is designed to assist a wide range of professionals including but not limited to the elementary classroom teacher, language arts specialists or supervisors and technology education consultants.

In a very organized way, these authors have described selected theories of language acquisition, a rationale for industrial arts/technology education in the elemenetary school and an empirical study of child language in a practical arts context. Their evidence is presented in a logical and believeable manner. Hands-on activities are included which emphasize the development of language skills under consideration.

In light of the strong concern at the international level regarding the use of effective educational methods, I would strongly urge all pre- and inservice teachers to read this publication to more fully understand the problems that young students encounter when achieving understandings in the academic disciplines of technology and language. In the end, it will be their own students who will reap the benefits of being educated for the 21st century.

John H. Lucy
President of TECC

Language Development in the Elementary School Technology Context

by

J.F.D. Ilott
H.G. Ilott

Monograph 14

1988

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TECC Publication Committee

1987-88

Clarence R. Calder, Jr., Chairperson
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University of Connecticut
Storrs, Connectuicut

Robert W. Nannay
University of Southern Maine
Gorham, Maine

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Introduction

Anthropologists, developmental psychologists, and sociolinguists agree that people — as a species and an individual — develop as they explore and understand their environment through the interaction of manipulative experience and language use. Neither the child nor the adult compartmentalizes these experiences — language and manipulation of the environment both fuse into conceptual development.

Language, both oral and written, emerges from a context, involves content, and reflects the intentions of the users. As language is used, all three aspects change. This interaction alters the person's perception of physical reality and language use. This simultaneous change of both physical and linguistic perceptions often escapes us in our traditional planning process for children. The consideration of simultaneous learning is a step toward acknowledging the reality of child development and enhancing the child's general learning.

The current emphasis on "language across the curriculum" arises from the awareness that language, either oral or written, is not an isolated subject but is rather a means toward experiencing, comprehending and expressing the child's world (Fox & Allen, 1983). Language, therefore is both the content and context of school (Cazden, 1972).

A study of elementary school technology (E.S.T.) as a curriculum area within the language across the curriculum emphasis is long overdue. E.S.T.'s quintessential blending of concrete and abstract tool use (ie. manual and linguistic tools) needs to be explored, and the simultaneous manipulation of physical and linguistic realities needs to be better understood. This monograph is an initial effort toward developing this understanding.

The purpose of this monography is to help teachers plan and organize instruction so that objectives of language learning may be met as part of technology activities. Thus, this monograph addresses several audiences. These include: 1) elementary teachers who have experience in organizing and managing activities as well as normal classrom routines, 2) elementary language arts consultants who help elementary classroom teachers organize and plan instruction, 3) technology teachers who work in a team with elementary teachers, and 4) technology consultants who advise elementary teachers. In summary, since this monograph assumes that the reader has previous experience in organizing and conducting activities with elementary school children, it is expected that each reader will find both familiar and new concepts. By combining the familiar with the novel a bridge may be built between technology and language arts.

The monograph is organized into two sections. The first, composed of Parts I and II, elaborates on the conceptual theoretical positions of this publication. The second section consisting of Parts III, IV, and V, blends theoretical principles with practical applications in the E.S.T. context.

Section I: Theoretical Considerations

Part I: Conceptual Bases

This monograph rests on three conceptual bases: 1) selected theories of language acquisition; 2) the rationale for technology in the elementary school; and 3) an empirical study of child language in an elementary school technology context.

Conceptual Basis I: Language Acquisition: The study of children's mastery of the language of their world has been the focus of many disciplines such as early childhood education, developmental psychology and psycholinguistics. Studies in these areas gives emphasis to oral language in contrast to language in written form. This oral language is seen as the foundation, precursor and co-variant of such important processes as reading and writing. Consequently, the child's acquisition of language is seen as the keystone for subsequent development in virtually all curriculum areas.

Children, it is believed, have a natural pre-disposition to acquire language. Although only partially understood, this attribute is considered to be "hard wired" or innate. However, language learning ability cannot automatically produce language mastery. Children also need both a stimulating physical environment for sensori-motor exploration as described by Piaget (1952) Halliday, 1979) and social interaction with speakers of the language as described by Bruner (1983) and Vygotsky (1934/1962).

Since the child begins to master many rudiments of interactive communication as an infant, the 5 year old child has achieved a high level of linguistic proficiency by school entry. It is now understood, however, that the "fine tuning" of these abilities extends well into the teen age years. This later language development can be explained by the close relationship between linguistic and conceptual development. Some people at all ages use language to understand, organize and explore their internal and external world; language learning continues well into the teen years and, to some degree, throughout adulthood as well. Thus, language is both the end to be mastered and the means of extending mastery.

Because of the all-encompassing nature of language, heuristic devices have been developed to describe its components. A widely used model by Bloom (1977) describes language as having three components: form, content and use. (Figure 1) Form refers to the regularities and rules of a specific language such as the sounds it employs, the ways plurals and verb tenses are derived and the order in which words are sequenced in making sentences. Content refers to the meaning or concept the words convey, i.e. the substances of the language. The third component, use, places language in a functional context — the way language is used internally to formulate and organize box though and behavior and externally to seek information, interact with others, request assistance, etc.

The sentence "May I have a larger one please?" can be analysed to illustrate these three components. The child's use of form can be identified by the placement of "may" before "I" in a question format and the use of "I" instead of "me" as a subjective pronoun. Content is well illustrated by the word "larger" which conveys the concept of relative size. Use is especially well indicated by the use of "one" instead of a specific noun, because the speaker knows the listener can infer the noun and "please" as a politeness marker. These three artificial divisions of language: form, content and use, which allow more precise exploration of the components of language and will provide the organizational framework for subsequent discussion of language in context.

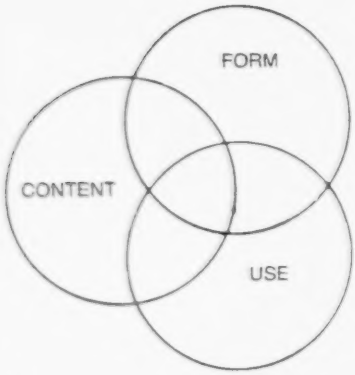

FIGURE 1. Model of Language Adapted from Bloom (1977)

Conceptual Basis II: Elementary Technology: In the elementary school technology has existed in one form or another under various names for a long time. But what is elementary school technology? Most people are likely to think of programs offered at the junior or senior high school level. Some may then try to translate these programs into an elementary school setting, and indeed, at times this has been done — complete with laboratories, or "shops" devoted to instruction of young children. For the most part, however, elementary school technology is different from secondary school technology.

Elementary school technology usually takes place in the children's regular classroom or in an "activity room". It is always an activity-based learning situation. E.S.T. often involves working with tools and materials; the tools and materials may or may not include those traditionally found in secondary school technology programs. Normally, careful planning of the activity by the child or by the children and teacher together is a prominent feature of E.S.T. The activities may be ones that others would call home economics, art, or science; the subject area distinctions are unimportant. Often E.S.T. includes activities that are representative of technology and our productive society. These may represent current technology or technology that is of historical importance. The activities may be undertaken so the children can learn to appreciate the lives of children of other cultures or other times.

Today there are two commonly held positions on the place of technology in the elementary schools. Taken to extremes, these positions would be at opposite ends of a continuum. In practice most of those who teach technology in the elementary school do not fit either of these two extremes. However, for contrast, these extreme positions are described here. First, the curriculum position — holders of this view maintain that technology should be included in the elementary school with a specified content for each grade level (Hoots, 1969). The other end of the continuum, the methodology position — holders of this view see technology as a method of a teaching those things that are already in the elementary school curriculum. Further, they believe this methodology might also

make the elementary school experience more meaningful to the child and link the school experience to the child's experience in the real world (Ilott 1977; Miller & Boyd 1985). In this monograph technology is viewed as a teaching methodology, a process rather than a discrete subject area.

Conceptual Basis III: A Study of Language in the E.S.T. Context: For several decades studies of child language have relied on recording children's language in a range of specific settings. To obtain ecological validity and in-depth analysis, only a few subjects have been the focus of such studies. (The hallmark work of Weir (1962) reported on one child, Brown (1973) on three.) The fundamental premise, supported by the contributions of such studies, continues to be that children develop language in amazingly similar patterns. Among normal children, one child does not differ markedly from another in the sequence in which stages of language acquisition emerge even though the rate at which the stages appear may vary (Brown, 1973; Dale, 1976).

To study language use in an E.S.T. context, summer workshops were organized. For two consecutive summers, two week activity programs were offered in a semi-rural school district. Children ranging in age from 8 years 1 month, to 11 years 7 months enrolled to make toys to be used through the summer. The group met for 3 hours each morning with a half hour break in the middle of the morning for a snack and free play. The first year 8 children attended. The second year 10 attended; of these, there were 4 boys and 6 girls. Two of the boys and 2 of the girls had also attended during the first year. Activities included woodworking, photography and a range of crafts. The predominant activity was woodworking with children constructi ng popular toys such as roller boards and stilts.

Collecting natural language data in intelligible form is always a challenge (Lund and Duchan, 1983). Data collection is further complicated when the noise of tools and materials masks audio-taped speech. For this study a peer instruction component was introduced to allow for language data collection. Each morning half of the children joined one instructor to prepare the morning snack; the other half remained in the classroom to receive instructions regarding the morning's activities. The verbal instructions and demonstration were augmented by partial notes including key words and dimensions on the chalkboard. When instructions and food preparation were completed, each child who had heard the instructions (Instructor) was paired with a child who had not heard the instructions (Listener). The Instructors were given the responsibility of explaining the procedure for the day's activity. Children were assigned to their respective roles and partnerships so that each child alternated between roles and interacted with each other child sometime in the two weeks; practice and interpersonal realtionships were balanced across children. The children who were Listeners before the activity, tape recorded instructions for a "friend who is absent" at the end of each morning. Thus, each child tape recorded instructions for each project in one of two different ways: preactivity of postactivity.

This procedure yielded 75 data tapes which were transcribed and then analyzed using the micro-computer program Lingquest (Mordecai, Palin & Palmer, 1982). The Lingquest program produces the following data for each transcript: 1) a lexical analysis (vocabulary used and frequency of each use); 2) a form analysis (the morphological elements such as verb tense, plural forms, etc.); and 3) syntactic analysis (forms of sentence development).

The language data cited in this monograph will be from the second year's program. During this program, 7 of the 10 children contributed 6 or more complete transcripts for analysis. Table 1 describing these children in general lanaguage analysis terms includes three rows of basic information: 1) choronological age; 2) mean total number of words used per transcript; and 3) mean total of different words used per transcript.

TABLE 1

Summary of Ages and Words Per Tanscript

CHILD	I	II	III	IV	V	VI	VII	GROUP MEAN
Chronological Age:	11Y 7M	11Y 6M	10Y 7M	10Y 3M	9Y 6M	9Y 1M	8Y 1M	10Y 1M
Mean Words/Transcript	118.87	213.86	122.14	127.13	91.63	119.63	39.25	118.95
Mean Diff. Words/Transcript	61.63	83.00	58.13	63.63	34.63	58.38	23.63	54.72

Data from this study will be used to illustrate subsequent discussions of adverbs, cause and effect relationships, quantifiers, and adjectives.

Part II: Elementary School Technology as a Context for Language Development

When viewed as a process with relevance across curriculum areas, elementary school technology can contribute to the general conceptual and linguistic growth of children. E.S.T. activities elicit a high level of interest from children (Ilott & Ilott, 1984). Specifically, if the end product is inherently valuable to children and the accurate use of language is a means towards achieving the child-valued end, children will use and develop functional language in its most powerful form. Teachers able to integrate objectives for activities and language can orchestrate the activities to increase the opportunities for language development.

The purpose of this section is to sensitize the teacher to the language development potential of E.S.T. activities. To make the complex area of language more manageable, the form, content and use components delineated by Bloom (1977) serve to organize topics. Illustrations are provided from the second of the summer workshops described above.

Language Content: By using an elementary school technology process for any subject matter some specific linguistic-conceptual components are potentially salient for the children involved. Linguistic analyses of children's speech during such activities helps to identify linguistic-cognitive growth opportunities.

Linguistically and conceptually, children tend to develop from the concrete to the abstract. The specific nature of E.S.T. fosters conceptual development at a range of levels. Beginning with the concrete manipulation of materials and the exploration of materials' characteristics and potentials, children can repeat or extend these experiences in the concrete mode. However, the children with both interest and appropriate cognitive development can proceed to additional experiences with models, diagrams and non-linguistic symbols. For example, children who have made stilts may explore the more abstract relational concept of "scale". To draw stilts or make model stilts, the size would be reduced but

the size relationship of one part to another would remain the same. Similarly, to make real stilts from a drawn plan, the ratio of one dimension to another would remain the same but all the parts would be larger than depicted in the drawing. Thus children could continue working at the concrete level or advance to a more abstract level.

Children expand and refine their language in a social context and become more precise language users as they interact with other speakers of their language. Although adults are usually cited as language models, other children serve important roles in language development as well. Children try to express things that are important to them in order to communicate their understandings and to organize their perceptual world. In the E.S.T. context this type of communication about a present experience is fostered. Children ask for words to label what they are experiencing, explore ways to express these experiences and try various strategies with others to determine the accuracy, suitability, and efficiency of language usage. The E.S.T. setting promotes the teacher's being "an adult talking to a child" (Lindfors, 1980) rather than being the director, judge, etc.. Children in the summer workshop often asked for more precise labels or for clarification of confusing terms. It also seemed possible to identify emerging mastery of a specific word across children. For example the word "image" provided difficulty for child IV who on day 5 said "draw ink across then image our area" instead of "draw ink across the image area" but by day 8 said "plan image on planning paper". This contrasted to child III who appeared to use the word "image" whenever possible as if practicing it. He talked about drawing "ink across the image area" and putting the "image in a safe place". He concluded each recording with the name of the summer program, saying "That is all from Images, Objects, and Words". Children I and II used the word casually as if it constituted an established part of their vocabularies.

Children extend from the present to the past and future in their conceptual and linguistic development. The concrete and present nature of most E.S.T. activities is central to the potential of this area of development. By experiencing an event, a child has a better conceptual base and possibly a greater interest in viewing this event within a historic time frame. The child working with pottery is more open to, and capable of comprehending the idea that the clay had an origin in a hillside, that it was once used by native people etc.. Similarly, it becomes logical and relevant that a completed clay piece is not immediately usable, and that a process that hardens this product is essential before a functional piece is completed. Thus, a child physically participating in one stage of a process is more able and willing to view this as an event with a related past and future.

Cognitively and linguistically, spatial concepts are among the more difficult for children to develop. Experience with materials typically involves three-dimensional space and complex relationships such as weight and volume. In expressing these experiences, the exact spatial relationship between items may be quite critical. In English these relationships are typically expressed by the use of prepositions. Analysis of child language transcripts showed that children use a wide range of prepositions in describing E.S.T. activities. The Lingquest analysis identified the following incidence of prepositions per child across transcripts. The total number of prepositions, the total different prepositions and the ratio of these measures is shown in Table 2.

TABLE 2

Summary: Prepositions Per Child

CHILD	I	II	III	IV	V	VI	VII
Total Prep.	120	160	91	138	83	103	44
No. Diff. Prep.	17	16	14	20	15	18	12
Type/Token Ratio	7.06	10	6.50	6.90	5.53	5.72	3.67

The most frequently used prepositions across the group and their usage by children are noted in Table 3.

TABLE 3

Most Frequently Used Prepositions

CHILD	I	II	III	IV	V	VI	VII	MEAN
PREPOSITIONS:								
to	21	41	17	25	19	33	7	23.30
on	22	12	10	18	17	14	8	14.40
with	8	21	14	11	9	20	8	13.00
of	14	20	11	8	9	10	7	11.30
in	5	16	10	12	11	9	8	10.10

Another later-developing conceptual/linguistic area is that of temporal relations. Activities which have several steps usually have specific sequences during which one step must precede the other for successful completion. Because sequences can be important for success, the child develops strategies for identifying, remembering and describing these critical sequences. The language data from children showed consistent use of temporal markers. These were evident by the inflection of voice (prosodic) or by the use of specific words (lexical). Typically the words "then" or "after that" were used. The total occurrence of temporal markers and the specific occurrence of "then" is noted in Table 4. A marked difference across individuals was apparent with one person using "then" 50 times; another used "then" only twice.

TABLE 4

Use of Temporal Markers

CHILD	I	II	III	IV	V	VI	VII	MEAN
Total Temp. Markers:	8	66	12	17	25	2	16	20.86
Total Use Then	6	50	8	16	20	2	14	16.57
Then/Total	0.75	0.76	0.67	0.94	0.80	1.00	0.88	0.83

Cause and effect relationships are also among the later developing, more advanced cognitive and linguistic concepts for children to master. E.S.T.

provides concrete experiences with cause-effect relationships. The language transcripts suggest that the use of words like "because" and "so" may have developmental trends. The use of "because" increased directly with chronological age, "so" showed a similar but less distinctive trend.

TABLE 5

Use of Because and So

CHILD	I	II	III	IV	V	VI	VII	MEAN
Chronological Age:	11Y 7M	11Y 6M	10Y 7M	10Y 3M	9Y 6M	9Y 1M	8Y 1M	
because	5	3	0	0	0	0	0	1.1
so	3	6	1	1	0	3	0	2.0

The language inherent is E.S.T. processes has counterparts in the language of children's experiences elsewhere. First, some words, such as an "alligator" clip, and the "eye" of the screw, are analogies and children seem to use these readily as if they comprehend the comparisons. Another group of familiar words acquire completely different meanings which initially confuse a few children. For example, the child for whom a file is a cardboard file folder may experience difficulty with the name of the tool "file". In a third group, the E.S.T. experience expands the comprehension of other familiar words. The child who has heard of a "raspy" voice but now experiences the use, feel and sound of a rasp attains a richer concept of the word meaning.

During E.S.T. activities specific adjectives become especially meaningful and are included spontaneously in children's converations. The rough-smooth contrast, which is often difficult for children to comprehend, became commonplace in the workshop data. Children spontaneously discussed the processes of "making things smooth", as opposed to things being "too rough". The number of adjectives used per child and the most frequently used adjectives are shown in Table 6.

TABLE 6

Adjective Use

CHILD	I	II	III	IV	V	VI	VII	MEAN
Total Adjectives:	13	22	10	9	9	5	2	10
round	5	5	1	2	1	2	0	2.3
smooth	2	2	2	2	0	1	0	1.3
blue	1	1	1	1	4	1	0	1.3
solar	2	1	2	0	2	0	0	1.0

Quantitative terms were so prevalent that the data was divided into two sections: a) numbers, and b) terms relating to number, size and physical dimension. The inter-individual variability in the use of numbers is notable, especially since all critical numbers were written on the chalkboard and therefore equally available to all the children.

TABLE 7

Number Use

CHILD	I	II	III	IV	V	VI	VII	MEAN
Total Number:	36	29	110	24	12	50	17	39.71

The total of quantitative words and the most frequently occurring of these words across children is show in Table 7 and 8.

TABLE 8

Quantitative Word Use

CHILD	I	II	III	IV	V	VI	VII	MEAN
Total Quantitative Words:	25	28	18	22	8	20	10	18.7
both	4	3	4	8	0	4	2	3.6
all	2	9	4	1	0	0	0	2.2
half	2	6	2	1	0	2	1	2.0
each	1	4	1	3	0	3	0	1.7

One interesting word could be considered a quantifier of force, or precision. All children used the word "carefully" or "careful" at some time in the program's tapes. All but one child used the word careful on Day 8 (solar grams) and carefully on Day 7 (felt pen on puppets) suggesting the strong influence of activity choice on vocabulary use.

Language Forms: The forms of language relate to regularities or rules and exceptions to these rules. The E.S.T. context not only allows practice with all common language forms, but also allows experience with some less typical forms.

In the English language, there is often an identifiable relationship between a verb and the derived noun. Children learn quite early that one who paints is a painter and one who sings is a singer. Later they learn patterns by which " doers" titles can be derived from the related noun e.g. a pianist plays a piano, and an artist produces art. The world of tools illustrates a similar but different pattern in that the noun naming some tools can be the same word as the verb for the tool's use, i.e. one can saw with a saw, drill with a drill. Some nouns like hammer can serve as one of the several appropriate verbs, e.g. people may hammer with a hammer but they can also pound with a hammer or even nail with a hammer. In some instances only part of the noun constitutes the related verb, e.g. one can sand with sandpaper. In contrast, the verb and the noun may have no apparent relationship — people do not talk about plying with pliers. The vocabularly inherent in tool use has the potential for expanding children's awareness of the relationship between some nouns and the corresponding verbs.

The nature of E.S.T. experiences also provide opportunities for some advanced sentence forms. First, the passive/active contrast occurs naturally during activites. Children casually shift from the active form "I'll saw that board"

to the passive form "That board was cut too short.". The constrast between the agent of the action and the recipient of the action is especially clear with inanimate materials. A more advanced syntactic mastery requires that a child order the important information that identifies 1) the agent performing the action, 2) the action performed, 3) the object receiving the action, and 4) the instrument by which the action is accomplished. Many children demonstrated the ability to organize such a statement, e.g. "I cut the dowel with the saw" or reorganize this into the even more advanced form of a question, e.g. "Did you drill the hole with this bit?" The concrete manipulative experiences of E.S.T. may have facilitated this accuracy for some children.

Language Use: Children learn to use language as their social context makes specific language functions valuable for them. The E.S.T. processes foster children interacting with materials, their own skills, the consulting adult and other children. In this way, many inter-active language roles become important and the child sees them as functional in helping complete the desired project.

One of the hallmark descriptions of the functions for which children use language was contributed by Halliday (1973). Smith (1977) expanded Halliday's work to list 10 functions apparent in child language. These are instrumental, regulatory, interactional, personal, heuristic, imaginative, representational, divertive, authoritative/contractual, and perpetuating. During the summer program most functions were evident. Although the functional use of language is expanded in Part V, the following illustrate a few:

Instrumental: "Would you hand me that saw?"

Regulatory: "Be careful with that"

Interaction: "Let's you and me work together, o.k.?"

In summary it is on the three conceptual bases described here that the subsequent development of this monograph rests. These conceptual bases have been 1) selected theories of language acquisition, 2) the rationale for technology in the elementary school, and 3) an empirical study of child language in an elementary school technology context.

Section II — Practical Applications

All educators face the challenge of putting theory into practice. This section of the monograph addresses that issue in three parts. The first, Part III, summarizes the steps necessary in implementing an elementary school technology project which fosters language development. The second, Part IV, is addressed to teachers who need assistance in initiating the E.S.T component. This part provides guidance in selecting a learning activity, planning its components and implementing it with children. The third, Part V, addresses the need for inter-active planning to capitalize upon opportunities for language development in context of the E.S.T. activities.

Part III: Steps to Implement E.S.T. and Language Development Activities: Procedures for Teachers

Figure 2, Steps to Implementation, shows the major steps to be followed in the implementation of an E.S.T. language development activity. The steps can be divided into major components: 1) teacher activities, planning and preparation, and 2) teacher-pupil activities. Many of the teacher activities occur prior to student involvement. The boxes in the figure show the teacher activities while the circles show the teacher-student activities. Although the figure depicts discrete sequential steps there will be overlap between the steps as well as some movement back and forth between steps. The various steps are described in the following text. Part IV of the monograph describes how these steps are carried out using an illustrative example. Expanded directions for fostering language development are detailed in Part V. The following directions are for the teacher or consultant, not for the children.

1. Select a Product
2. Make the Product
3. Modify as Necessary
4. Compile Lists
5. Analyze Production Steps
6. Plan for Language Development
7. Prepare Activity
8. Place with Children
9. Demonstrate Procedures
10. Assist and Monitor
11. Clean Up
12. Facilitate Closure and Evaluation
13. Evaluate by Teacher

FIGURE 2. Steps to Implementation

Step 1: Select a Product.

Select a product which will be inherently interesting to the children. Consider the abilities of the children, your own abilities in organizing and executing such a project, the tools and materials available, and the physical space in which you will work. Be sure the processes of the activity are comfortable for you so that you can establish and maintain a comfortable environment that fosters functional language use.

Step 2: Making the Product.

In selecting activities from any source, you must expect that the activity may not work as described. There are several reasons for this. Sometimes there are differences: in the materials, equipment and facilities available; in the children's range of abilities; in your knowledge, skill and ability; or in your

interpretation of the product description. However, some critical step, tool, material, or characteristic of the facility may have been omitted in the source. All of these can be identified by constructing the product yourself.

Step 3: Modifying as Necessary.

When necessary, identify alternative materials that are appropriate for the tools, facilities, abilities and funds available. Be sure, however, that a downgrading of materials does not make the product unacceptable. Conversely, unsuccessful products may be improved by upgrading the quality of material. (In Part IV this will be illustrated from our experience substituting plastic drain pipe for a cardboard roll in the construction of a roller board.)

Step 4: Compile Lists.

Analyze the modified product to produce parallel lists that note steps to be taken in production, material requirements and tool requirements for each person.

Step 5: Analyze Production Steps.

Identify production steps which are critical for success and those during which the children can have some latitude either for error or for proceeding according to their own plans. Similarly, analyze the steps to see if specific safety precautions need to be taken or whether advance preparation of materials is necessary. Some dimensions are so critical to product success that special equipment such as jigs, molds, and templates are needed to assure success.

Step 6: Plan for Language Development.

Identify the stages of the process that facilitate language development. Modify details of the procedure so that these goals are truly functional in the completion of the product. Be prepared to capitalize on spontaneous opportunities to expand and extend language abilities. As the teacher gains experience with inter-active planning, Step 6 can co-occur with Step 1 as illustrated in Table 13.

Step 7: Prepare Activity.

Obtain the materials and complete any advance preparation of space, tools, or materials. Products that take extensive teacher preparation should be reconsidered; they are unlikely to add to the teacher's continuing repertoire of activities.

Step 8: Plan with Children.

Plan with children before they begin using materials and tools. Specific modifications to facilitate language use should also be introduced at this point. Use your usual strategies for discussion and topic development, but remain aware that for the children to be both safe and successful, a few steps may not be negotiable. Sometimes good safety practices or critical steps require specific methods which limit the choices available to children.

Step 9: Demonstrate Procedures.

Demonstrate all procedures, using the correct tools and materials and explaining important rationale. Involve the children in discussing why certain steps must precede others. Write notes for each step on the chalkboard to increase understanding of the process and provide a source children can check if they forget any information.

Step 10: Assist and Monitor.

As children proceed, be available to assist and monitor for safety. Foster cooperation among the children, reducing direct dependence on the teacher as much as possible.

Step 11: Clean Up.

When the product is completed, include cleaning the work place and returning tools and materials to a prescribed area as part of the activity. Although safety guidelines for use of the product had been delineated in the planning phase, these should be reiterated now.

Step 12: Facilitate Closure and Evaluation.

The evaluation phase of the activity is not unlike that for many other kinds of activities. It lends itself to exploring novel areas of the children's interests and provides opportunities to bridge from this activity to others.

Step 13: Evaluate by Teacher.

After all aspects of the activity have been completed, teachers should add their own evaluation of the project as a whole to assist in subsequent use of the activity. Once a teacher has mastered the presentation of an activity, it can be used many times with variations to accommodate different children and situations. For example, our summer program became known as "the place to make stilts". After two presentations, the processes for this activity were well established and could be modified for a range of students thus assuring product success.

As a teacher develops greater confidence and competence in using activities involving tools and materials, the range of opportunities expands. Not only does the teacher have an expanded repertoire, but the teacher is now able to utilize these special organization and preparation skills to enable parents or members of the community to share their special interests and skills with children.

Part IV: Preparing an Elementary School Technology Learning Activity

This section describes the planning and preparation activity necessary to develop an E.S.T. activity for one summer workshop session. Steps from the Procedures for Teachers are expanded and illustrated to assist teachers in initiating the E.S.T. component.

First, it is necessary to consider the objectives and constraints of the activity. For example, for the first day of the summer workshop where we gathered child language data, the objectives were specific to that situation. Details from the activity used for the first day of the second summer workshop follow.

Objectives. An activity for the first day of the summer workshop needed to be highly motivational so the children would return eagerly the subsequent day. In addition, the activity needed to be one which could be completed in one session and about which each child (the children were unknown to us) could feel successful. The activity also needed to be something the children could use for the balance of the summer. Furthermore, the intent was that the activity should introduce the children to some simple hand woodworking tools that would help provide a base of skill and knowledge for later activities.

Constraints. The space available to us for doing the summer workshop was an activity room equipped with sinks and tables in an elementary school. The tools for the children were borrowed from the local junior high school. Given that this was to be a first day activity, the children would only have an hour to work once direct instruction and other organizational activities were completed. Cost of materials had to be reasonably low and materials had to be available in the small town where the summer workshop took place.

Step 1: Select a Product.

The first step in selecting a suitable project was to peruse several books of activities and projects for children. The eventual choice was the roller board. The source that provided this activity identified materials, gave an indication of procedures, and provided an incomplete tool list. In this instance the board itself was to be made of plywood, with two hardwood strips attached; the roller was to be made from the cardboard rolls on which carpet is rolled when it is sold. These materials would likely be affordable and available.

Step 2: Make the Product Yourself.

Having selected an activity the next step was to produce a prototype. The purpose of this was to identify any "fatal" flaws in the product, appraise the difficulty of the activity, consider possible ways to improve it and see if the completed product would indeed function as planned. Depending on the initial instructions provided in the source and any subsequent variations, additional planning for the actual activity would likely be required at this point.

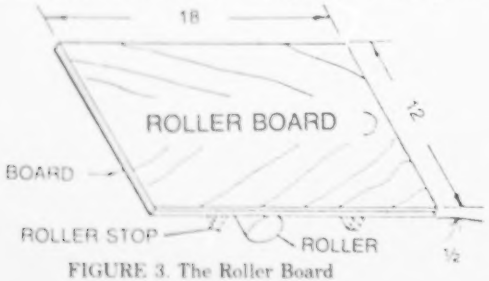

FIGURE 3. The Roller Board

In the case of the roller board it was known that the roller stops would not be hardwood and a decision had to be made about their precise location. The size of the board itself was also decided at this point. These dimensional and material decisions were tentative as it was only a prototype that was being made. In fact, the prototype roller board had the following dimensions:

1. Board size: 1/2 inch thick plywood, 12 inches by 18 inches (this because up to 20 boards could be cut from one 4 by 8 foot sheet of plywood with very little waste)
2. Roller stops: 3/4 by 1 by 12 inches located 5 1/2 inches from each end of the board (2 required)
3. Roller: 2 1/2 inch diameter 12 inches long cardboard carpet roll.

Then the prototype board was made using the tools that the children would use. Time required to make the roller board was also noted.

Step 3: Modify as Necessary.

Having completed the prototype, it could now be evaluated. The first thing checked in this instance was its utility. Could it be used by a child of the age taking part in the summer workshop? Was the roller board an entertaining toy? As a toy the roller board was very successful; the child who tried playing with the roller board enjoyed it very much. Two problems in design soon became apparent, however. First the original placement of the rollerstop strips needed to be changed. They were too close together restricting motion of the board. Second, and much more serious, the cardboard roll began to collapse.

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Solutions to the two problems noted above were easily identified: move the roller stops and substitute ABS plastic drain pipe at slightly greater expense for the cardboard roll. The roller board project could not be evaluated for "do-ability" by a group of children without experience in using woodworking tools.

In general, there were two related problems concerning the do-ability of the activity. The children would be unlikely to have sufficient skill to make the roller board and they would not be able to complete it in one workshop day. Three solutions are possible for these kinds of problems: 1) the design of the product can be simplified, 2) ways can be found to decrease the skill requirements of the product, and 3) some of the work required to make the product can be done in advance by precutting materials or otherwise simplifying the tasks the childen must accomplish. The roller board was already a very simple design so the solution lay in reducing skill requirements, speeding processes, and precutting materials. Reducing skill requirements and speeding processes can usually be accomplished through making "jigs", simple specialized tools that facilitate the making of a particular product.

Step 4: Compile Lists

Once the design of the product has been stabilized it is necessary to make several lists and, depending on the extent of the redesign, it may be necessary to actually make and evaluate another example of the product. (In the case of the roller board a second prototype was not necessary.) The first list needed is a Materials List for one project. This list of materials required to make one roller boards is as follows:

TABLE 9

Materials List

QUANTITY	PART NAME	PART DESCRIPTION
one	board	½" plywood 12" X 18"
two	roller stops	¾" X 1" X 12" solid wood
six	box nails	3 penny (1¼")
	glue	Carpenter's glue (e.g. Elmer's LePage's etc.)
one	roller	2" diameter X 12" ABS drain pipe
1/6 sheet	abrasive paper	120 grit
	finish	Danish Oil

The second list includes the sequence of production steps and the tools required for each step as follows:

TABLE 10

Procedures, Steps and Tools

STEP	PROCEDURES	TOOLS
1	Mark a line on the large board so it may be cut to length	Pencil and board measuring jig
2	Saw the board to length	Hand saw
3	Measure two roller stops	Pencil and board
4	Saw the two roller stops	Hand saw
5	Round ends of roller stop	File
6	Sand edges and top of board	Sand paper
7	Mark location of roller stops on bottom board	Stop measuring jig and pencil
8	Mark location of nails on top of board	Nail location jig and pencil
9	Start 3 nails for one roller stop	Hammer
10	Spread glue on one roller stop	
11	Place roller stop on mark on bottom of board and nail	Hammer
12	Repeat steps 9, 10, and 11 for second roller stop	
13	Clean excess glue off board	Stick & paper towel
14	Put assebled roller board aside for glue to dry	
15	Cut roller to length	Hand saw and roller cutting jig
16	Smooth rough cut edges of roller	Half round file
17	Optional, put coat of oil on board	Rag or paper towel

Step 5: Analyze Production Steps

The list of Procedures, Steps and Tools indicates that several special tools or jigs are required. In the case of the roller board, the need for these special tools was determined earlier as a result of Step 3. Jigs are special tools that are made to facilitate the construction of a particular project. Usually jigs can not be purchased but must be designed and made to suit the product. Jigs reduce the skill level required to make a project and increase the speed with which the product can be made. Usually jigs are only of value if several copies of a product will be made. The more copies that are made, the more time and effort that can be put into the construction of jigs. Several simple jigs were constructed for the roller board activity.

Board measuring jig. With this very simple jig children do not need to measure accurately or use a square to draw a line across the board where the board should be sawn. To use the jig, they simply hook it over the end of the long piece of material and draw a line.

Stop measuring jig. This jig is very similar to the board measuring jig and is used in the same way.

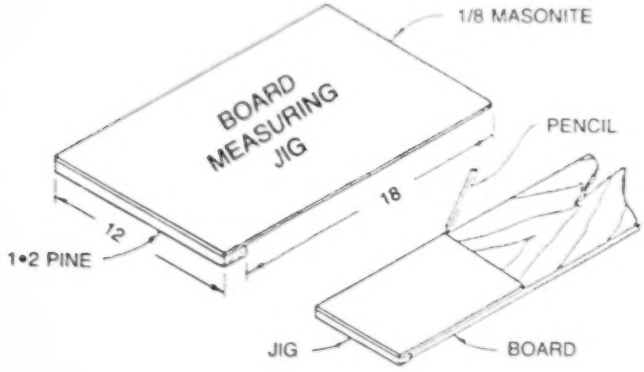

FIGURE 4. Board Measuring Jig

Once again, this speeds the measuring process and makes the location of the roller stops much more accurate than children of the expected skill level would otherwise be able to achieve.

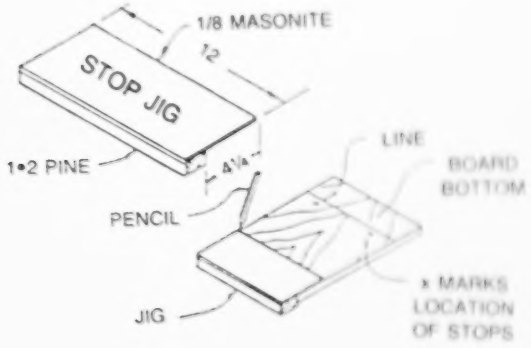

FIGURE 5. Stop Measuring Jig

Nail location jig. This jig is much like the previous jigs. In fact, it could have been combined with the board measuring jig except that too many children might have needed the same tool at the same time, so a separate jig was made.

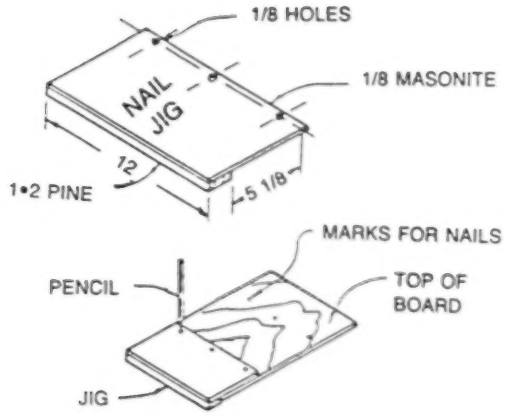

FIGURE 6. Nail Location Jig

This jig allows the children to mark where they need to place nails to hold the roller stops in place on the board.

Roller cutting jig. This jig does a little more than the previous three jigs; it not only removes the need for accurate measurement from the children's work but helps to hold the material while they are sawing it. Actually, this jig is simply a specialized form of a common tool called a mitre box.

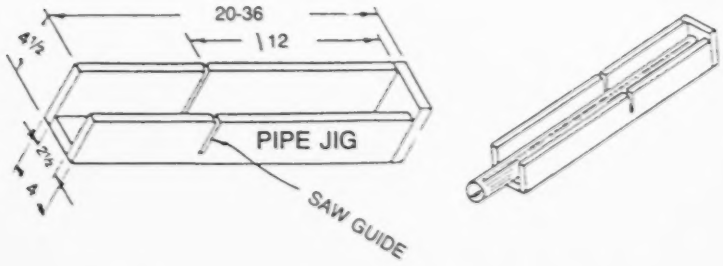

FIGURE 7. Roller Cutting Jig

Examination of the lists produced in Step 4 also reveal some materials that require advance preparation. The plywood needs to be cut into pieces that are 12 inches wide and eight feet long. Since wood that measures ¾ inch think by 1 inch wide, is not readily available in most lumber yards the material for the roller stops would also need some advance preparation. Another material that

needs advance preparation is sandpaper, more correctly called "abrasive paper" or "coated abrasive". Typically abrasive paper is made in stock sheets measuring 9 inches by 12 inches. To avoid expensive waste, the abrasive paper should be cut into smaller pieces. 4½ X 6 inches or better yet, 3 X 4½ inches.

The list of tools must also be examined to see if anything unusual is required or if anything has been omitted. In this case, only a few different tools were required. One additional tool that might be needed, depending on how the facility is equipped, is the C-clamp. As the facility being used was an elementary school classroom, work benches with vises for holding work were not available. C-clamps in combination with work tables were a reasonable substitute.

Step 6: Plan Language Development

Although the roller board activity used for illustration in this monograph was a vehicle to observe language use and development, the roller board would also be a suitable vehicle to foster language development. Part V of this monograph explains how to plan for the inclusion of language development objectives using the Functional Language Goals/Activity Stages Matrix.

Step 7: Prepare Activity

This section examines the preparation of space, and tools as well as the procurment and preparation of materials. Although situations vary widely, there are some generalizations that can be examined profitably through consideration of the roller board activity.

Space. First, an examination of space requirements. A great deal depends upon how the teacher organizes activities. If the whole class will be working on the same project at the same time, the requirements will be different than when the class is organized on an activity center basis with only a few children working on any one product. The latter has two forms. Several activities may be in process at one time or a small group may be working on the roller board activity while the balance of the class is doing something else. In any of the three cases above, an activity room would be useful. However the roller board may be constructed easily in a normal classroom. Most importantly, the children need room to work. When the whole class takes part in a single activity it is helpful to assign specific areas for certain tasks. For example, gluing may be done at the counter by the sink while sawing is to be done at the table near the door. In an activity center environment, however, probably the entire activity would need to be confined to one or two centers.

Space needs to be assigned for the storage of tools and materials. The largest piece of material that needs to come into the classroom for the roller board is the material for the board itself. It would be most convenient if pieces 12 inches wide and 8 feet long could be stored in the classroom although these could be stored elsewhere and brought into the classroom as needed. Similarly the roller stop material will likely be 8 feet long. The pipe used for the roller is 12 feet long but could be cut in two for storage. Glue, nails, abrasive paper, finishing material and rags or paper towels all need to have a space in which to be stored. It is important that these storage spaces be identified and that the children be taught where to obtain material and even more importantly, where to put materials away when they are through using them.

Storage space also must be arranged for partially completed projects. If work on the project is to extend over several days, children will need a place to put the various pieces so they can find their own materials on subsequent days.

Incidentally, much grief can be avoided if children put their names on each piece of material as they get it. Along with these space problems is the related one of garbage, a satisfactory place to put refuse is needed. There is the special problem of disposing of rags or paper towels that have been used with an oil finishing material, oil based paints or paint thinners. Danger of fire starting in waste of this nature is very real. Oily waste should be disposed of in a closed fire proof container and removed from the building.

Tools. The only tools needed by children for the roller board are: hand saw, hammer, half round file, C-clamp and the jigs that were specially made for this product. Tools should be "real", not toys; real work cannot be done with toys. Sometimes it is possible to obtain small tools for the use of children, but these must be real tools. A description of satisfactory tools for children to use in making the roller board follows.

TABLE II

Tools for Rollerboard

NAME	FULL NAME	DESCRIPTION
Saw	Cross Cut Panel Saw	Also known as a cross cut hand saw, this saw is used to cut across the grain of wood and to cut plywood. The size depends on the length of the blade and the number of teeth per inch of blade. Most often these saws are about 26 inches long with 8 teeth per inch. For children, an 18 to 20 inch blade with 10 teeth per inch is better.
Hammer	Claw Hammer	Sometimes called a carpenter's hammer. Hammers are sized by the weight of the hammer head in ounces. For children 7 to 13 ounce hammers are the best choices.
File	Cabinet File	Wood rasps are usually too coarse for children but a half round cabinet file of 8 to 10 inch length works well for most jobs. Be sure the file has a handle for safety.
Clamp	C-Clamp	Available in many sizes, the C-Clamp is used for clamping and holding work. Children find 4 inch light or medium duty clamps easiest to use.

How many tools are required? This obviously depends on the number of children working on the activity at any one time. A group of four or five children, working in an activity center, to make the roller board would require: one saw, one hammer, one half round file and about four C-clamps. Certainly, a whole class doing the same activity would need more tools, but less than a straight multiple of the number required for four or five children. Tools even more than materials, need a place to be stored when they are not in use. Tool storage should be in a convenient place where each child can return each tool when through.

Materials. Having made a list of materials required for one copy of the product, all that remains is to: 1) determine how many copies will be required; 2) allow for waste or error; 3) translate the requirements into stock sizes; 4) go shopping; and 5) do any required advance preparation of material. An analysis of each of these steps for the roller board follows.

First, how many copies of the product? Usually one for each child and one for demonstrating procedures. With the plywood, waste is unlikely and error probably will not cause waste. For the roller stops, allowance for both waste and error will need to be made. In this instance add about 20 percent; the material is relatively cheap and a little extra would be useful for many other activities. No allowance for error or waste need be made for the roller; extra material might be difficult to use in other products and none is required for demonstration. Nails: each product requires 6; add 50 percent because nails are cheap and useful for many projects. Glue, like nails, is inexpensive and has many uses; be sure to have more than enough.

Not knowing how many children would appear for the first day of the summer workshop, a guess of twelve was made. Therefore the basic number of roller boards on which to base planning was twelve. The amount of each material to purchase was based on this number as were "guesstimates" about waste et cetera as shown in the table below.

TABLE 12

Roller Board Materials

MATERIAL	AMOUNT FOR ONE	NO. OF COPIES	TOTAL PLUS EXTRAS	STOCK SIZE	PURCHASE	
Plywood	12" x 18"	13	13	48" x 96"	1 sheet	a
Roller						
Stop	24"	13	375"	96"	4 pieces	b
Pipe	12"	12	144"	12'	1 length	c
Nails	6	13	117	1 lb.	1 lb.	d
Glue				8 oz.	8 oz.	e

Notes for Table 12:

a. Plywood is sold in 4' x 8' sheets; sometimes "offcuts" or smaller pieces are sold. In this case, since more than half a sheet is needed it is probably best to buy the whole sheet.

b. Most common lumber is sold in eight foot or longer lengths, eight feet being the most common length for small cross sectional sizes.

c. Pipe is usually sold in 12 foot lengths; most stores do not sell smaller pieces.

d. Nails are sold by the pound or package; one pound in this size is more than adequate.

e. Glue is sold in many sizes of container; 8 oz. should be a great plenty.

While shopping, or perhaps before, some other decisions must be made. In the case of the roller board the decisions and rationale were as follows:

1. **Plywood:** there are many kinds; it should be strong, quality of surface is not important, and it should not delaminate if it becomes wet, therefore, the cheapest exterior (CDX or sheathing) grade is adequate.
2. **Roller Stops:** the cheapest "dimension lumber" is usually "one by two" (actually ¾" by 1½"), the cheapest grade will do.
3. **Pipe:** the black ABS drain pipe will do. Pipe is sized by its diameter, but this is its inside diameter so a 2" pipe is about 2¼" in exterior diameter.
4. **Nails:** 1¼" or 3d (d means penny, a "three penny" nail is 1¼" long) box nails.
5. **Glue:** there are many brands, it should be fast drying, easy to clean up and water resistant. Yellow carpenter's glue is satisfactory.

Two of the materials needed advance preparation. The plywood was cut into four pieces 12" wide. The "one by two" roller stop material was cut into pieces ¾" x 1".

Steps 8 to 12.

Steps eight through twelve are listed previously as 8) plan with children, 9) demonstrate results, 10) assist and monitor, 11) clean up, and 12) facilitate closure and evaluation.

These steps are straight-forward for an experienced teacher. The roller board example does not need to be carried through this section except it must be remembered to plan in order to foster language development.

Step 13: Evaluate by Teacher.

One point of doing an evaluation at the completion of the activity is to decide if it is worth repeating with another class at another time. The evaluation needs to consider several points. Was there sufficient educational value to make the project worthwhile? What could be done to increase "payoff" in terms of learning? What could be done to make the project more manageable for the teacher or make the manipulation of tools and materials more efficient or satisfying for the children?

As far as the roller board was concerned, two things might have been done to make it easier for the teacher; one of these might also help the children. First, the roller stops would have functioned as well if they had been made of material that was ¾ inches x 1½ inches thus saving the teacher a materials preparation task. The wider roller stop would also be easier for the children to nail into. This change would also require shorter nails, 1 1/8 inch shingle nails would probably do. The second change that might be possible would be to have the lumber yard cut the plywood into 12 inch wide strips. Some lumber yards will perform this kind of service for their customers.

Although no mention was made of finishing material in the section on materials, it was mentioned earlier. An oil finish is easy to apply and children enjoy doing it. There is a fire danger (spontaneous combustion of oily rags) and a problem of storing this finishing material. Oil-based finishes should be stored in fire resistant cupboards, many schools have regulations covering these materials. The roller board works just fine without a finish but applying a finish will give those children who work quickly an extra, rewarding task to do and improve the appearance of the board. In order to avoid the problems of oil based finishes it might be best to use a water based finish. Some (eg. Deft) are available with an applicator that also reduces clean-up problems.

Part V: Fostering Language Development Within E.S.T. Processes

Fostering language as it appears in the E.S.T. context can be achieved by nter-active planning of the language components. The first option for planning occurs when the objectives for the activity are stated. Within those objectives can be one or more which relate directly to linguistic-cognitive development. For example, the activity could be chosen because it includes measurement concepts or because two materials of the same size have markedly different weights. The second option is selecting an E.S.T. project carefully and adapting the project to maximize language learning. In this more typical approach the central aspect of teacher planning focuses upon the child's motivation to complete a product successfully.

Children are likely to accept whatever contributes toward achieving the goal and resist whatever appears to be a barrier. A change in the usual activity process—making a tape recorded log of the process, for example—can be introduced at the outset and be seen as part of the overall activity. If introduced after the activity has begun, however, such a modification may be viewed as an artificial barrier. Most children will work with deliberate accuracy to copy dimensions from a chalk board, negotiate fair and expedient arrangements to share tools, explain certain steps of the production process, and incorporate creative modifications according to their own plans. They may not, however, participate effectively in non-functional language activities or artificial conversations. Children themselves are great critics of the functional potential of activity components. The teacher who is planning dual language and E.S.T. objectives must remember to keep the language component "real".

In all classroom learning there are planned lessons and spontaneous opportunities. Even the spontaneous opportunities may be somewhat predictable because a specific context makes some forms of spontaneous learning very probable. Elementary technology lends itself to both spontaneous and planned language oportunities.

Spontaneous Opportunities for Developing Language.

Children are natural language learners, they assimilate important aspects of their environment including the language that describes and organizes it. We all have words that we learned because we "wanted" that word for a purpose of our own. By capitalizing on children's "wanting" for efficient, communicative words we effectively foster language growth. Creating an environment that fosters this "wanting" is the other aspect critical to such teaching.

Most language growth occurs as a child interacts verbally with another speaker of the language. Studies of these exchanges are valuable — and extensive. Across the studies, several nearly universal strategies have been identified which take place between an experienced language user (Senior/Sr.) and one with less experience with the language of that specific context (Junior/Jr.) (Oksaar, 1982). A conversation between older and younger children or people with greater and less experience are also valuable examples of this relationship. Three of the strategies occurring in such relationships will be briefly surveyed here. Since most teachers will recognize these as familiar, frequently-used strategies, the pupose is to identify the suitability of including these as an integral part of E.S.T. processes.

Modeling: Naturally, in the course of interacting, the senior speaker will employ language terms, structures, etc. less familiar to the junior partner.

Providing new words in context-appropriate ways is among the most effective language-teaching strategies available. Identifying the critical terms relevant to personal experience is a natural ability for normal language learners. Teachers may formalize this in a group setting, but should keep in mind the principle that children learn what they perceive as potentially functional for them. Thus, although a teacher may introduce a tool formally to an entire group as "This is a coping saw but this is a back saw", extending this to a lengthy naming of tools without obvious, imminent use for this information does little to enhance language growth.

By being sensitive to 1) the natural learning that can result from access to a good model, and 2) the specific language/conceptual components of the immediate context which may merit modeling, the teacher can provide valuable contextual learning opportunities for children.

Expansion: Another basic language-fostering technique is incidental expansion. This relates to the senior partner's attention and response to reactions, comments, etc. of the junior partner. The critical factor in applying this typically automatic response in a conscious way is that the junior speaker controls the situation. Thus, it is not a springboard for information-giving by the senior speaker. The pattern is for the senior speaker to accept what the junior speaker contributes and expand it slightly.

a. Jr.: "That feels neat"

b. Sr.: "Yes, your sanding made it nice and smooth."

In this exchange it is important to note that the Sr. partner does not pursue the topic further unless the Jr. partner advances the topic.

c. Jr.: "Will sanding make rocks smooth, too?"

Expansion takes many forms—simple addition as above, as well as these forms:

1. Restatement with more accurate terms:
   a. Jr.: "I put that gookey stuff on"
   b. Sr.: "Yes, you put the contact cement on".
2. Answer questions:
   a. Jr.: "Why is this wood bumpy?"
   b. Sr.: "Because of the unevenness in the wood we call the grain of the wood."
3. Subtle correction:
   a. Jr.: "I put the fuzzy plywood there."
   b. Sr.: "I guess you mean the fir plywood, don't you?"

To restate, the critical principle of expansion is that it is a dialogue, a partnership, a turn-taking process. The senior partner adds to the dialogue, enriches the content, but does not control the exchange. Most importantly, when the junior partner changes or concludes the topic, the senior partner changes or concludes the topic as well.

Scaffolding: The concept of scaffolding has been referred to as the LASS, Language Acquisition Support System (Bruner, 1983). This resembles the turn-taking of the expansion strategies described above except that the senior partner assumes greater responsibility in helping the junior member complete a statement. This process is common to individual coaching or tutoring exchanges, and is also readily adaptable to the flexible interaction patterns possible during E.S.T. processes.

Scaffolding requires that the Sr. partner identify the statement the Jr.

partner is trying to formulate and then provide whatever assistance appears necessary to assure success. As the child becomes more capable of formulating information, the Sr. partner reduces the linguistic scaffold and the Jr. partner provides more of the necessary structure to make the statement effective.

As an example, maximum support can be provided by trying to state the idea for the child and ask for confirmation as to whether you expressed the idea accurately: "Do you want me to help you get the brace and bit down?" In contrast, a child with the ability to express some ideas might be helped by the Sr. partner's provision of only the new, more difficult terms: "What do you want me to do with the brace and bit?" In this case the child only needs to supply more familiar words "get it down". Reducing the support even further, the senior partner can supply the familiar words "What do you want me to do?" and rely on the Jr. partner to supply the more complex idea "Get down the brace and bit". At this level the child is providing almost all the critical information without assistance and only minimal scaffolding has been supplied.

In summary, during scaffolding the Sr. partner 1) provides the linguistic support that is needed, 2) provides no more support than is necessary, and 3) decreases that support as the Jr. member develops greater facility or accuracy. These strategies are typical of exchanges between Sr. and Jr. speakers and seem to occur naturally without training. Using these strategies within the E.S.T. context, however, requires that the teacher see E.S.T. as a language-learning context during which such strategies are extremely appropriate.

The previous section on the planning of roller board construction illustrated the first steps in project planning. After the activity had reached the stage described in the analysis of steps in Part IV, the language potential of the process could be considered. To do this the teacher would need to review the tools, materials and procedures chosen and anticipate children's reactions to these experiences. On the basis of this alone, several language learning opportunities will be evident. The teacher can then capitalize on these, probably using a combination of the strategies described above.

In the product planned in Section IV these language opportunities can be easily identified. 1) The word "jig" probably has an entirely different meaning in this context. Children already familiar with the word jig probably think of it as a dance or type of puzzle. 2) Pipe as plastic tubing is probably new also, as most children may think of pipe as something to smoke or as metal tubing. 3) Concepts of flammability and safety procedures associated with these are likely to be new both conceptually and linguistically. 4) The word abrasive occurs here in its most literal sense and expands the meaning of the more common figurative use. 5) The word finish is typically used in schools as a verb as in "Finish your work", but here occurs as a noun as well-the oil makes the finish.

In a more general sense, several areas also merit attention. Children unfamiliar with tools will be learning names of common tools. Others may only have the half round file as a new term. The C-clamp allows a recognition that the name comes from its shape like the letter C. In this particular activity children do not use routine measurements such as inches and feet. The use of jigs reduces part of the linguistic demands as well as the performance demands. If measurement terms were introduced at a later time, however, these terms might require special support. Perhaps the most difficult notation for children during our workshop was the use of "x" as the word "by" in such descriptors

as 2 x 4. Special explanation of such usage seems merited when this notation is first used.

Another general concern that arose several times in the workshop was the relationship between sex role and tool use. The idea that girls aren't good tool-users pervaded some of the early sessions but was not supported by the experience as the program evolved. Girls as less experienced tool users, however, seemed true at the outset. In our experience, the general attitude of cross-gender abilities was fostered when both of us did all activities. When the woman helped saw and the man helped cook, the children seemed to follow the example, and the discussion of which were "girl jobs" and which were "boy jobs" seemed to be replaced by discussion of the shared activity.

Among the interesting spontaneous opportunities for cognitive-linguistic development were the post-activity developments which the projects and children suggested. For example, children were eager to return with the "next chapter" of how they used their product—how far they walked on stilts, how long they balanced on the roller board, etc.. Some activities could be based on principles typically explored in science—balance, gravity, forces, etc.—and a successful product may lead to questions as children try to understand why things work in predictable ways.

Children often direct attention to a new concept which merits development. For example, if children see a toy catalog listing a roller board at many times the cost of the one they produced, this may lead to discussion of labor costs and profit margins. A teacher receptive to spontaneous post-activity development can extend the immediate value of E.S.T. activities.

Planned Opportunities for Developing Language:

Many language learning opportunities, as illustrated above, occur spontaneously. Others, however, are so predictable that more precise planning can be used to capture the inter-active potential of E.S.T. activities and language learning. Among the ways to foster inter-active planning is the use of a matrix on which stages of the activity are placed on the horizontal axis and components of language on the vertical axis.

Because putting language competenices into a wide range of functional uses is frequently the aim of all language learning programs, and because the interaction with people and materials in an E.S.T. context fosters this development, the functional use of language is a particularly appropriate focus for inter-active planning. The matrix shown in this section has been used to plan the interaction between the stages of the activity and the uses of language. This matrix features Smith's (1977) extension of Halliday's (1973) language functions. The entries in the respective squares may guide teacher-controlled planning as well as prepare the teacher to capitalize on spontaneous language opportunities that are highly probable in this context.

For example, in the roller board activity several uses of functional language are central to the process. Children need to share tools which may require somewhat complex requesting and negotiating strategies. Typically the child who grabs and demands will be far less successful than the child who says "Can I use that after you?" or "Can we trade? I'll give you the hammer if you give me the saw". Also requests are frequent in the E.S.T. context—requests for help, explanation, sharing etc., and children show improvement over time in formulating these requests clearly. Recognizing the E.S.T. potential for these

TABLE 13

Functional Language Goals by Activity Stages Matrix

FUNCTIONAL LANGUAGE GOALS	STAGES OF ACTIVITY			
	PLANNING	EXECUTING	CLEAN-UP	EVALUATION
Instrumental: "I need/want."	Have children help decide what space and tool arrangements will be necessary.	Facilitate functional use of requesting behavior. Prompt the less successful.		
Regulatory: "I'll tell you what to do".			Allow "specialists" to direct aspects of clean-up; use leadership, not authoritarian model.	
Personal: "I feel/I am."	Sex role discussions often emerge; e.g., "Girls can't saw". Support flexible roles, not stereotypes.		Encourage children to describe personal variations on product construction and anticipated use of product.	
Interactional: "Let's"	Arrange compatible pairs of children with tools that need to be shared. Support efforts at problem solving.	Encourage helpful, cooperative approach. Do not, however, usurp leadership of "specialists."		
Imaginative: "Just imagine."	Allow children to plan variations to personalize their product.			Ask children to visualize: "What would have happened if we'd _____?"

Heuristic: "What/why?"	Encourage questions to clarify steps in the process as notes are being formulated.	Help children who have forgotten details to structure questions to obtain complete information. Encourage them to direct questions to effective peers.		
Representational: "I'll give you information."	Have children develop notes on the chalkboard as reminders of the exact procedure.			Allow opportunities for children to describe their experiences either in writing or on a tape recorder.
Divertive: "Just for fun."		Children often develop puns and "corny jokes" around new words that are analagous to familiar words, e.g. alligator clip or rat tail files. Enjoy.		
Authoritative: "These are the rules."	Discuss rationale for safety rules, then state in rule form.			
Perpertuating: "According to History."	Clearly explain how modern materials differ from those of the pioneers etc. when the product relates to historical products.			

(from Ilott, and Ilott, 1984)

wide-ranging language functions is the purpose of inter-active planning as illustrated in the accompanying matrix. For the teacher capitalizing on this inter-active use, however, a word of caution is necessary. Children who are developing normally can benefit from opportunities for language use in a motivating context. This does not mean that these children will necessarily use specific language components as the teacher anticipates. To set language objectives that children "pass" or "fail" would be directly counter to the purpose of inter-active planning and should not be considered as part of this approach.

As a teacher observes children operating in the E.S.T. context and gains experience in capitalizing on the inter-active potential of language learning and E.S.T., further development will be possible. After developing facility with this approach, the teacher can begin fusing the two processes earlier in the planning procedure by selecting activities with specific language learning potential. The goal of inter-active planning for language goals and elementary technology is to recognize that in school-age children, language and manipulation of the environment fuse into conceptual development.

Conclusion

Children learn best what they experience. Both language development and elementary school technology rest on this premise. This monograph has explored the blending of these, advocating the simultaneous exploration of physical and linguistic realities.

The teacher who identifies inter-active objectives and employs processes of inter-active planning can promote children's language development within the elementary school technology context. This natural integration of the concrete and language environments contributes to children's conceptual development.

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